INTERFACIAL REACTION BETWEEN SAC305 AND SAC405 LEAD-FREE SOLDERS AND ELECTROLESS NICKEL/IMMERSION SILVER (ENImAg) SURFACE FINISH

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Dedicated to my beloved father and mother who taught me to trust in Allah, love, encouragement and prays of day and night make me able to get such success.

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ABSTRACT

The different surface finish and solder size on printed circuit board strongly affect the formation of intermetallic compounds (IMCs) and solder joint reliability. Among of various surface finish in the electronic industry, electroless nickel/immersion gold is the most popular at the moment. However, because their black pad issues, electroless nickel/immersion silver (ENImAg) was developed as an alternative surface finish. Therefore, the effect on an interfacial reaction between lead-free solder and ENImAg surface finish using different solder ball size (Ø300μm, Ø500μm and Ø700μm) was investigated. All samples were subjected to an aging process with different aging times. The characterizations of IMC formation were examined by image analyzer, scanning electron microscopy and energy dispersive x-ray. The results showed that ENImAg finish was free from the black pad nickel. Subsequently, the solder ball size has a significant effect on the IMC formation and fracture surface of as-reflowed and aged solder joint. The IMC thickness of larger solder balls was found to be thicker (1.74 μm) than smaller solder balls (1.32 μm) during soldering. In contrast to aged solder joints, the smaller solder ball produced thicker (3.51 μm) IMC compared to bigger solder balls (2.47 μm). Furthermore, the fracture surface of smaller solder ball size showed ductile mode for both reflowed and aged solder joints. In addition, the solder joint on ENImAg surface finish displayed a thinner layer and smaller grain sizes compared to solder joint on bare copper.

ABSTRAK

Kemasan permukaan dan saiz bebola yang berbeza ke atas papan litar bercetak memberi kesan terhadap pembentukan sebatian antara logam (IMC) dan kebolehpercayaan penyambungan pateri. Antara pelbagai kemasan permukaan dalam industri elektronik, nikel tanpa elektrik/rendaman emas adalah yang paling popular pada masa ini. Bagaimanapun, disebabkan oleh isu pad hitam, nikel tanpa elektrik/rendaman perak (ENImAg) dihasilkan sebagai alternatif kemasaan permukaan. Oleh itu, kesan terhadap tindak balas antara muka di antara pateri bebas plumbum dan kemasan permukaan ENImAg bersama-sama dengan saiz bebola pateri yang berbeza iaitu Ø300μm, Ø500μm and Ø700μm telah dijalankan. Semua sampel melalui proses penuaan dengan masa penuaan yang berbeza. Ciri-ciri pembentukan IMC telah dianalisis dengan menggunakan penganalisis imej, mikroskop imbasan electron (SEM) dan tenaga serakan x-ray. Hasil keputusan menunjukkan bahawa, kemasan ENImAg didapati bebas daripada pad hitam nikel. Seterusnya, saiz bebola pateri mempunyai kesan yang ketara terhadap pembentukan IMC dan kekuatan ricih selepas proses pengaliran semula dan penuaan. Bola pateri yang bersaiz besar mempunyai ketebalan (1.74 μm) IMC yang lebih tebal berbanding bebola pateri bersaiz kecil (1.32 μm) ketika proses pengaliran semula. Berbeza daripada bebola pateri yang terdedah pada suhu penuaan, bebola pateri yang lebih kecil menghasilkan ketebalan (3.51 μm) IMC yang lebih tebal berbanding bebola pateri yg bersaiz besar (2.47 μm). Tambahan pula, selepas proses pengaliran semula dan penuaan, permukaan patah untuk bebola pateri yan bersaiz kecil menunjukkan mod mulur. Tambahan lagi, penyambungan pateri ke atas kemasan permukaan ENImAg menghasilkan IMC yang nipis, dan saiz bijian yang kecil berbanding penyambungan pateri ke atas tembaga.

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LIST OF SYMBOLS AND ABBREVIATIONS

Ag	-	Silver
Au	-	Gold
Cu	-	Copper
In	-	Indium
Ni	-	Nickel
P	-	Phosphorous
Pb	-	Lead
Pd	-	Palladium
Sb	-	Antimony
Sn	-	Tin
Zn	-	Zinc
BGA		- Ball Grid Array
CPU		- Central Processing Unit
DCA		- Direct Chip Attach
DIP		- Dual in Line Package
ECA		- Electrical Circuit Assembly
EDX		- Energy Dispersive X-Ray
ENEPIG		- Electroless Nickel/Electroless Palladium/Immersion Gold
ENIG		- Electroless Nickel/Immersion Gold
ENiImAg		- Electroless Nickel/Immersion Silver
FC		- Flip Chip
FESEM		- Field Emission Scanning Electron Microscope

HASL	- Hot-Air Solder Levelling
I/O	- Input/Output
IC	- Integrated Circuit
ImAg	- Immersion Silver
IMC	- Intermetallic Compound
ImSn	- Immersion Tin
JEDEC	- Joint Electron Device Engineering Council
JEIDA	- Japan Electronic Industries Development Association
MCM	- Multi Chip Module
NEMI	- National Electronic Manufacturing Initiative
OM	- Optical Microscope
OSP	- Organic Solderability Preservative (OSP)
PBB	- Poly-Brominated Biphenyls
PBDE	- Poly-Brominated Diphenyl Ethers
PCB	- Printed Circuit Board
PTH	- Plated Through Hole
PWB	- Printed Wire Bond
RoHS	- Restriction of Hazardous Substance
SAC	- Tin-Silver-Cooper
SEM	- Scanning Electron Microscope
SMD	- Surface Mount Device
SMT	- Surface Mount Technology
TAB	- Tape Automated Bonding
TCM	- Thermal Conduction Module
WEEE	- Waste from Electrical and Electronic Equipment
XRD	- X-ray Diffraction

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